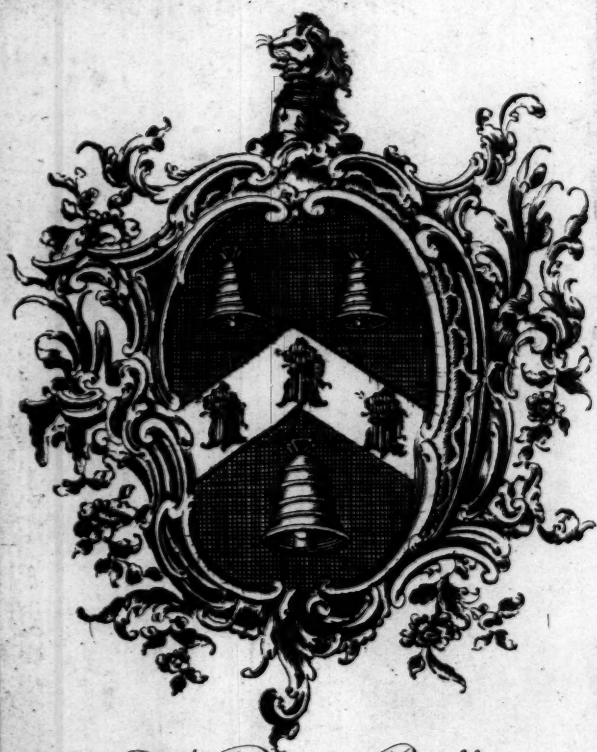
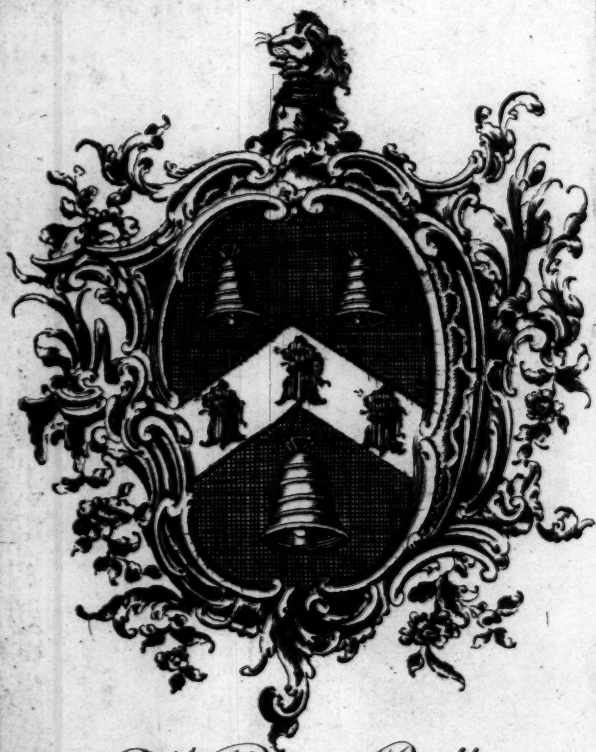
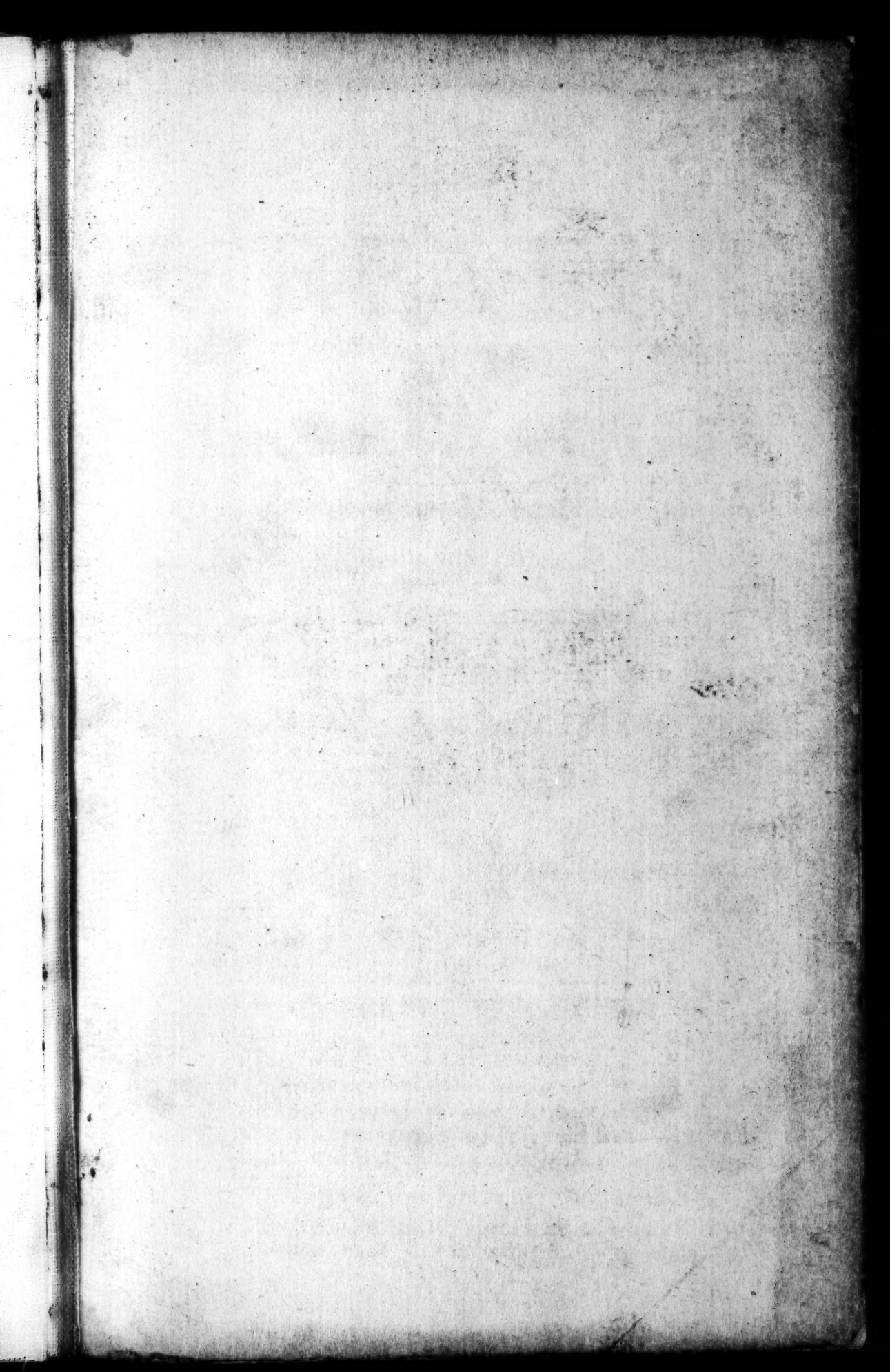




*William Bell,
Ulcomb, Kent.*



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A
TREATISE

ON THE
BATH WATERS:

Wherein are DISCOVER'D,
THE SEVERAL
PRINCIPLES of which they are COMPOS'D;
THE
CAUSE of their HEAT;
AND THE
MANNER of their PRODUCTION.

BY

RICE CHARLETON,
Of BATH, M.B. F.R.S.

*—Inter se quia nexus principiorum
Diffimiles constant,——
Incolumi remanent res corpore, dum satis acris
Vis obeat pro textura cujusque reperta.——*LUCRET.

BATH: Printed by T. BODDELY.
And Sold by J. LEAKE, and W. FREDERICK, in BATH; R. DODSLEY,
in LONDON; and J. FLETCHER, in OXFORD. 1754.

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Fit obest pro tactum respiciat experia. —————
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Chemical Analysis, &c.

CHAPTER I.

*Of the MINERAL SUBSTANCES which the
BATH WATERS bring up with them
out of the Earth.*

THE Origin and Course of the
BATH WATERS being unknown,
we are deprived of those Helps in our
Search after their constituent Principles,
which an Examination of the Substances
they run through would afford. For as
all such Waters derive their Virtues from

the Bodies they dissolve during their Continuance in the Bowels of the Earth, or from the Steams of fermenting Minerals with which they are there impregnated; an Investigation of this Kind is too essential and too useful a Part of their *Analysis* not to be regretted, when we are deprived of its Assistance. But this Defect in the present Enquiry is however, in some Measure, supplied by the following Substances, which the Current of these Springs forces up from beneath.

THE First, is a very peculiar Sort of Sand, of a dark Grey Colour. It appears to the Eye to consist chiefly of small Chrystals, like those of common Sand, intermix'd with black shining Particles, and Pieces, of a white chalky Earth. But when submitted to a Chemical Examination, we find in it an Alcaline Principle, Iron and Brimstone.

THE

THE 1st is evident from the violent Fermentation which Acids produce with it.

THE 2d from digesting it for a few Days in pure distill'd Rain-Water, which will thence become possess'd of all the Properties of a Natural Chalybeat: Or, if a Loadstone is moved about in this Sand, several small Particles of Iron will be attracted from thence by it.

THE 3d Ingredient which enters its Composition, *viz.* Brimstone, is discoverable from strewing a small Quantity of this Sand on a red-hot Poker, where it yields a blue Flame, and a suffocating Vapour: Or, from confining some of it in a Retort, whence the true acid Spirit of that Mineral may be obtained by Distillation.

To this Sand succeeds a soft black Mud, of a strong sulphurous Smell;

which yields by the before-mention'd Process, a considerable Quantity of a tasteless, limpid, fœtid Water, that fermented with neither Acids nor Alkalies. The Neck of the Retort was lined with a fine straw-colour'd Powder, which glitter'd, was tasteless, and gave no blue Flame in Burning; but the Vapour which arose from it was something acid and suffocating. This Mud being rubb'd on Silver changes it black.†

IN some of the Spring and Summer Months, it is usual to see large black Cakes floating on the Surface of these Waters. They have been supposed to be some bituminous Matter, but are, in Reality, a Moss ‡, as is evident by keeping a Part of them for a few Hours in a

† BOTH the Sand and Mud are found in the Cisterns, which are placed over the Springs of the several Baths.

‡ Mr. Ray in his *Sinopsis Stirp. Britannic.* calls this Plant the *Jelly-Moss*.—*Conferva Gelatinosa, omnium tenerrima & minima Aquarum limo innascens.*

Glass of common Water, which by washing off the Mud in which it grows, and that clots its Fibres together, gives them Liberty to expand, and to demonstrate their being a Vegetable from their *Figure*. By Distillation it produces the usual component Principles of its Tribe; from whence, with its being commonly to be found in other Places †, it cannot be supposed to impart any peculiar Virtues to the BATH WATERS: But how far they are obliged to either of the two preceding Substances in this Respect, we shall have a more fit Opportunity hereafter of shewing, when it is discovered of what Ingredients they are composed.

† Gaudat limo nigro tenero & pingui & in Fossis purioribus passim circa Londinum observetur toto fere anno.

Synop. Stirp. Britan.

C H A P. II.

Of the CHALYBEAT PRINCIPLE *in the*
BATH WATERS.

THE BATH WATERS have ever been deem'd Chalybeat; and it is evident they are so, as well from their Smell and Taste, as from the Phænomena produced in them by their Mixture with the following Materials.

1st. THE Water of each Bath, *viz.* the King's, Hot, and Cross, instantly changed with Powder of Galls to a rich Purple.

2d. WITH a few Grains of powder'd Logwood, they at first struck a reddish Purple, and in less than a Quarter of an Hour turn'd of a deep Violet.

3d.

3d. WITH Green Tea they acquir'd the same Colour as with Galls, but much fainter.

4th. WITH Pomegranate Bark, they became of a blueish Cast, when placed in some Lights; and of a greenish Yellow in others, like those changeable Silks, whose Colours vary according to the different Points of View they are observed in.

5th. BALAUSTINES† produced in these Waters a Colour, which at first resembled that of Galls, but it afterwards alter'd to a greenish Hue.

THESE Changes which Galls and other similar Substances excite in Mineral Waters, are held to be a sure Criterion of their containing a Chalybeat Principle; and Experiments of this Sort are commonly confined to a bare Demonstration of its Existence. But as it has

† Flowers of the Wild Pomegranate Tree.

been found by frequent Trials, that such Waters *vary* from the faintest Shade of Purple to the deepest Black, in Proportion to the Quantity of this Ingredient, which they are possess'd of ; and as they require a larger or a smaller Quantity of Galls to bring them to their highest Tint, in the same Ratio ; such Experiments may be conducted to a more useful Purpose, than that to which they are commonly assigned : For it becomes a Matter of no great Difficulty by preparing an *Artificial Chalybeat* Water, in which a known Portion of this Metal is dissolved, to determine how much of it exists in the *Natural One* : It being a necessary Consequence of the above Observations, that where two Waters strike the same Colour with equal Quantities of Galls, that each must contain the same Quantity of Iron.

MR. *Monro*, of *Edinburgh*, to whom the physical World is much obliged for
many

many useful and curious Discoveries, has in the third Volume of the *Medical Essay*, given us one on the present Subject; in which he says, that in the Salt of Steel the Proportion of Iron is little more than a third Part, and that by dissolving one Ounce of it in twenty Ounces of Water, 142 Drops of which Solution weigh 2 Drams, every such Drop will contain $\frac{1}{75}$ of a Grain of Iron.

I PREPARED such a Solution of the Salt of Steel, by dissolving 240 Grains of it in 10 Ounces *Averdupois*†, of Water, and found, by a very accurate Balance, that 97 Drops of it, let fall from a small Glass Tube, exactly weigh'd 2 Drams. These Drops were therefore larger than those in Mr. *Monro's* Calculation, and each of them contains $\frac{1}{47}$ of a Grain of Iron.

† This is mention'd, because in Mr. *Monro's* Solution, the Water was weigh'd by Troy Ounces.

AT the same Time, a strong Tincture of Galls was also made, by digesting one Ounce of them in Powder, with a Pint of Rain Water, in a gentle Heat for some Days ; and with these Helps I proceeded in the following Manner, to discover the Quantity of the Chalybeat Principle, with which the BATH WATERS are impregnated.

I DROP'D the Tincture of Galls from a small Glafs Tube, in different Quantities, into Pint Glasses, of the same Shape and Thickness ; and then immediately fill'd them with the Water as it came hot from the Pump. It was found, by repeated Trials, that 10 Drops of this Tincture were the precise Number, which brought the Water of the King's Bath to its highest Tint ; and that five Drops were sufficient for this Purpose in those of the Hot and Cross Baths.

THE Water of the King's Bath struck a warm, rich, rosy Purple; the others only differed from it in their Shades being lighter.

To imitate the Colour of the King's Bath-Water, two Drops of the Solution of Iron above-mention'd, added to three Pints of pure Rain Water, were sufficient. For thus an artificial Chalybeat was produced, one Pint of which struck, with 10 Drops of the Tincture of Galls, a Purple, from which that of the Natural One was not to be distinguish'd, but by the Warmth and Richness of its Tint.

It appears therefore from the preceding Experiments, that the Chalybeat Principle in a Pint of the King's Bath Water, is equal to the Quantity of Iron contain'd in two Thirds of a Drop of the Solution; which, by Calculation, comes out to be $\frac{2}{7}$ of a Grain nearly;
and

and as the Waters of the Hot and Cross Baths are but of Half its Strength, there is in a Pint of either of these only $\frac{1}{14}$ Part of a Grain.

THIS Discovery, at first Sight, may seem prejudicial to their Reputation; but it would be doing the highest Injustice to these Waters, should we attempt to explain their Virtues from only a Part of their Composition; or attribute to one Ingredient, what results from the happy Combination of *Several*. Besides, this seeming Prejudice will be entirely remov'd, if it be considered, that the same Method of Investigation being applied to other Chalybeate Waters, shews they are all impregnated with this Principle, in a Degree infinitely inferior to what might be imagined.

SHOULD we not alter our Opinion of the Powers of Steel Medicines from hence? And conclude, as Nature deals this Mineral
out

out so sparingly, in her most fanative Compositions, that its Efficacy depends far less on Quantity than the common Usage of prescribing it supposes.

It has been said, that the Chalybeate Principle of the Bath Waters is *volatile*; that they loose it by keeping; and thro' its Escape, become vapid and effete. The Falsity of which Position will be shewn by the following Experiments.

I. HAVING fill'd a large Bottle at the Pump of the King's Bath; a wet Bladder emptied of its Air and with its Surface well oil'd, was tied closely over its Mouth; after a Time, the Bladder became distended, and the Vapour which was thus collected, being gathered into a large Bubble, was sunk to the Bottom of a Glass which contain'd a weak Tincture of Galls. Upon running a Pin into that Part of the Bladder, where this Vapour was,
it

it rush'd out with considerable Noise, produced great Agitation in the Liquor, and fill'd it with Blebs of Air, which burst as they arriv'd at its Surface; but excited no Alteration in its Colour, or shew'd the least Marks of a *volatile Chalybeat*.

2. A LARGE Quantity of the King's Bath Water was distill'd from a Retort, in whose Neck a Hole was made, thro' which its more volatile Parts might escape; over this Hole was placed a Piece of spongy Paper, that had been soak'd in a strong Tincture of Galls. The Paper was roll'd up into a conical Shape, and cover'd with a Glass Bell, which condensed those Vapours which arose in the Distillation, and return'd them again upon it. The Consequence of this Experiment was, that tho' the Paper became thoroughly wet with the Vapour, yet it was changed to neither a Purple or a black Colour. 3. I

3. I PUT into a Receiver a few Fragments of a Gall Nut, and distill'd the Water of the same Bath into it from a Glass Retort, having first of all well secured their Junction by Cement and wet Bladders. The Water which was thus distill'd, remain'd entirely free from any the least Tint, which could raise a Suspicion of its being impregnated with Iron.

THE receiv'd Notion therefore, that the Bath Waters contain a *Volatile Chalybeate* Principle, is without Foundation. Surely its Effects must have appear'd in one or other of these Trials, either of which was so susceptible of demonstrating its Existence: For one Drop of a weak Solution of Iron tinctur'd the Fluids of the first and third Experiments with a very distinguishable Purple, and being poured on the Paper which was used in the Second, (after it was dry) gave

gave it a Blackness equal to what it would have acquir'd, had it been dipped in Ink.

BUT it may be asked, if the Chalybeat Principle of the Bath Waters is not *volatile*, and does not fly off from them; why do they loose their Power of tinging with Galls by being kept? The following Experiments will tell us.

Two Florence Flasks were filled with this Water, and their Noses inverted into Decanters of the same. One of the Flasks was quite full; the other had an Air Bubble left on its Surface of two and $\frac{1}{2}$ Inches Diameter. After 24 Hours, each was examined with Galls. The Water in the Flask where the Air Bubble was left, shew'd scarcely any tinging Property; but that in the other, which was quite fill'd, struck immediately a
vivid

vivid Purple, nearly equal to what it gives when just taken from the Pump.

HENCE we see the Water is depriv'd of this Power by a bare communication with the Air; and that, even when it is preserved in such a situation as renders the escape of its Chalybeat Principle impossible. It would be absurd to suppose *this* could pass thro' the Pores of the Glass; or granting *it* to be capable of obtaining such a passage, 'twill be a matter of the utmost difficulty to explain, why *it* did not leave the Waters in each Flask alike?

It is to the Air therefore alone, that such alterations are to be attributed, which, (to use the words of a very judicious Writer †) 'by its incessant 'elastic Action, promotes some degree

† See Dr. Hales Experiments on Steel Waters, &c. Page 105.

' of Agitation or Ferment in the Wa-
 ' ter, causing the mineral Particles there-
 ' by to disintangle themselves from the
 ' Water, and to coalesce into new Com-
 ' binations of so much larger Size as
 ' disqualifies them to be any longer
 ' suspended in the Water ; they then
 ' precipitating to the bottom and sides
 ' of the Bottles, partly in the form of
 ' a yellowish Ocre, and partly in cloudy
 ' Flocks or Thrumbs.

WHERE the Air is secluded, no change
 of this kind ensues ; nor does it happen
 to a Water with which some acid Spirits
 have been mixed ; these being repug-
 nant to any putrid Agitation which that
 restless Element can excite †. Besides it

† Acid Spirits, besides their Power of preventing any putrid
 Agitation in the Water, have still a further one which greatly
 contributes to preserve its tinging Properties, and that is their
 keeping the Chalybeate Principle sufficiently dissolved, attenu-
 ated, and mixed with the Water : And hence, by dropping Spirit
 of Sulphur, or Spirit of Vitriol, into the Bath Waters, I have
 preserved their tinging Properties for a great length of Time,
 tho' the Bottles in which they were kept have been corked only
 in a common manner. Without these acid Spirits, the Waters
 are intirely deprived of them in a few Days.

is a Fact, that when the Bath Waters have lost their tinging Properties, they will acquire them again after they have undergone a thorough Fermentation ; which it would be impossible they could do, was their Chalybeat Principle *volatile*.

WHAT these Waters principally lose when they are withdrawn from their Spring, is their Elementary Fire.

I HAD a Glass Vessel made of a Globular shape, from whence arose two Tubes, the one Capillary, the other of $\frac{1}{4}$ of an Inch diameter, and both of three Inches in length. This Vessel was fill'd with the Water of the King's-Bath, taken hot from the Pump, to the top of each Tube ; the larger of which was then covered with a piece of Gold-Beater's Skin, and some Putty, which separated its Contents from all contact with

the external Air. By the next Morning the Water in the Capillary Tube had sunk 2 and $\frac{1}{2}$ Inches nearly, and required fix Grains of the same Water (which was cold) to raise it to the Height it was first at.

HENCE we see the Bath Water increases in its specific Gravity, as this Principle flies off from it; and that its particles approach nearer to each other, and the whole volume of the Fluid is condens'd. Which alteration in the Arrangement and Mixture of its component parts, join'd to the loss of this Ætherial Fire, is probably the reason why its Virtues can never be restored, when it is once grown cold.

THE Heat of the several Baths, as taken by *Farenheit's* Mercurial Thermometer, is as follows:

THE Water of the King's-Bath, where

where it is of the greatest Warmth, raises the Mercury to 103 degrees; and sinks it from thence, in its coolest Part, to 100.

THE Thermometer stands in the Hot-Bath at 100, or 101.

THE different degrees of Heat in the Cross-Bath, are 93 and 94.

THE Heat of the Queen's-Bath, is from 99 to 98.

THE Waters which are pump'd up from the *Cisterns* of the several Baths for *Drinking*, and which are convey'd thro' Pipes immediately from their Source, were found to be of various Degrees of Heat, at different times of Trial.

THUS the Water which flows from the Pump of the Cross-Bath, has descended from 110 degrees, thro' all the

intermediate ones, to 105.—That of the Hot-Bath, from 116 to 112.—And the Water of the King's-Bath Pump, from 116 to 114.

It is usually thought, that the Bath Water retains its Heat longer than common Water heated to the same degree; but it did not appear to do so, by the most accurate Experiments that could be made.

It were to be wished among the several conveniences of Bathing and Pumping which the different Heats of these Baths afford, that we had a *Vapour* Bath; or a contrivance to let out the Steam of the Water (to which an artificial Heat might be given where the natural one was insufficient) on any part of the Body whence Obstructions were to be removed. The Advantages of such an Application are much superior in many Cases to the
com-

common methods of Pumping, and are attended with none of its Inconveniences.

THE amazing Power of warm Vapour has been abundantly shewn by its effects in *Papin's Digester*, where the hardest Bones are in a few moments rendered soft and pappy ; but a simple Experiment is sufficient for our purpose, to demonstrate how much more penetrating and dissolvent Water is when thus rarefied, than in a more condensed state, tho' possess'd of the greatest Heat it is capable of attaining.

Put a small quantity of Salt of Tartar into a Glass Pan, and tye a piece of dry Bladder over its Mouth : Now boiling Water may be for a long time poured on this Bladder, without getting through its Pores ; whereas the Steams of such Water gain an immediate admission, which

they demonstrate by dissolving the Salt almost as soon as they are applied.

THE Inconveniences of *Pumping*, proceed from the Weight and Pressure of the Water, which (together with its Heat) excite a vibratory and impulsive motion in the obstructed Vessels, that pushes forward their stagnant Contents. If these are liquid enough to pass the bounds of their confinement, Success will attend the application. But where they are too viscid; where they are endued with an acrimonious Disposition; where the Constitution of the Patient is hot and feverish; or at least in that state at the time of using the *Pump*, an Inflammation of the Part must be the consequence; which, if great care be not taken, is followed by a Generation of *Matter*, whose most favourable termination calls for the *Caustic* or *Incision-Knife*.

BUT

BUT none of these *Ills* can proceed from the *Vapour* Bath : It removes Obstructions by dissolving the hardened Juices which form them, and not by stimulating the Vessels to push them forward thro' narrower *Passes* into the wider *Roads* of *Circulation*. The Particles of Water in this attenuated state, find an entrance thro' the Pores which is denied them in any other ; and by the relaxing Quality which these Vapours possess, they open an easy passage thro' the Skin for the obstructed *Humours*, while they liquify them sufficiently to make their escape.

C H A P. III.

Of the SULPHUREOUS PRINCIPLE *in the*
BATH WATERS.

IT is a controverted Point, whether or no the Bath Waters are impregnated with Sulphur. Probably the indiscriminate use of that *Term*, and of common *Brimstone*, has been the occasion of this dispute. The latter is only applicable to a particular Mineral, whose Characteristics are its yellowish colour ; its great Inflammability ; its burning with a blue Flame, and an acid suffocating Vapour : Whereas the former should be understood in a much more extensive Sense, so as to comprehend all *unctuous Bodies* in general. And hence, if any such can be discovered in these Springs, it has all just right to be called their sulphureous Prin-

Principle, how much soever it may differ from common Brimstone.

It has already been shewn that this Mineral exists in the Bath Sand; but whether it actually enters the Composition of the Waters, is what I shall here endeavour to decide.

I JUDGED that the most likely Means of Success would be to make artificial Brimstone Waters, and to add a diversity of Mixtures to them, and to the Bath Water at the same Time: It would be thus easy to discover how far the Phenomena produced in each agreed; and consequently whether the natural Water was impregnated with the same Ingredient as the artificial one, or not.

WITH this View, therefore, there was prepared two sorts of Brimstone Waters. The *first*, by melting the Flowers of Brimstone with Salt of Tartar

tar, which together constitute a mixed Body that readily dissolves in Water. The *second*, by pouring common Spring Water on pounded Stone Brimstone, and returning it on again after it had soak'd through, 'till it became sufficiently saturated with that Mineral.

To equal quantities of these Fluids, there were added 30 Drops of a Solution of *Sublimate* in distill'd Rain Water; and at the same Time a like Number were dropp'd into that of the Bath.

NUMBER 1. Or the Water prepared with Brimstone and Salt of Tartar, changed instantly to a fine Orange Colour: Afterwards it grew thick, and let fall a yellowish Sediment; which being dried, was flung on a red-hot Iron, where it burnt with a blue Flame.

NUMBER 2. Or the artificial Water

ter made from Brimstone alone, appeared of a beautiful Pearl when held from the Light; but opposite to it of a Straw Colour. On standing it became opake and milky, and a fine white Powder precipitated which burnt blue on a hot Iron.

THE Bath Water shewed no alteration at first from this Mixture: But at length a Scum arose, and cover'd its Surface, which reflected an infinite Variety of the most beautiful Colours.

FROM this Class of Experiments, we find that the Bath Water bears no kind of Similitude to the artificial ones: We shall therefore examine them with a Solution of *Quicksilver* in *Aqua Fortis*, added to each in the same Quantity as before. With this:

NUMBER I, became first of an Orange

Orange, and afterwards turn'd to a Pearl Colour. Its Precipitation, which was of a Cream, yielded a weak blue Flame in burning.

NUMBER 2. became milky. In a side Light the Mixture had a blueish Tint; in an opposite one, a faint Yellow. The Powder which was deposited at the bottom of the Glass, was white, and burnt blue.

THE Bath Waters reflected a fine bright Orange. Its Sediment was of the same Cast, and shewed no Signs of Inflammability.

We here find some Resemblance between the Bath Water and Number 1, which consists in their both striking pretty nearly the same Colour: But as this is owing to the *alkaline* Principle that each contains, as will be shewn when we come to treat of the Salts and Earths

Earths which are in the Bath Waters ; it must not from this Similarity alone be concluded that they are both impregnated with the same sulphureous Ingredient.

A THIRD Trial was made on each of these Waters with a Solution of Silver in *Aqua Fortis*.

IN Number 1, the Liquor at top was of a dirty White, at bottom of a dark Brown. The Precipitation was of a greyish Colour, and burnt with a pale Blue.

IN Number 2, the Fluid was dark and muddy. A black shining Powder subsided, which flamed with a vivid Blue.

IN the Bath Water, dark Clouds were instantly form'd, which gradually becoming black, at length descended

scended and formed a Sediment of the same Colour. This black Matter gave no Flame on a red-hot Iron, but smoak'd much, and turn'd to a Calx.

ALL these Waters agree here in one particular, which is the Blackness they give to the Silver that's precipitated. This we know is one of the properties of common Brimstone; it is owing to the acid part of that Substance; and other Mineral Acids are capable of producing the same. Thus if pure distill'd Rain Water is well saturated with common Salt that has been purified for Use, it changes the Silver which it precipitates equally black with the above-mention'd Waters. It does not therefore follow from this Experiment alone, without the assistance of other concurrent Proofs, that the Bath Water is impregnated with *common Brimstone*. But upon the whole the contrary is to be concluded, seeing
its

its Precipitations have no where in these trials produced the genuine and distinguishing Characteristics of that Mineral, viz. a *blue Flame* and a *suffocating acid Vapour*. To which we may add, that no alterations are produced in the Bath Waters with *Fossil* Acids; whose well known property it is to precipitate this *Body* from the Menstruum in which it is dissolv'd, and at the same time to occasion a most foetid disagreeable smell. Neither does their Residuum (the solid contents of the Water obtained by evaporation) when flung on a red-hot Iron, or on live Coals, give any cause to suspect the contrary; which it most certainly would do, was ever so small a portion of real Brimstone mixed with it.

As this Mineral therefore does not enter into the composition of the Bath Waters, I shall proceed to another species of Enquiry by which the Nature and

D

Ex-

Existence of their *true* sulphureous Principle will be discover'd and ascertain'd.

ONE dram of Salt of Tartar, and four drams of the Residuum of these Waters, were ground together into a powder, and kept in a Crucible over a strong Fire till they grew quite hot. This powder was immediately flung into a Florence Flask, which contained about half a pint of pure Rectified Spirit of Wine. The Spirit quickly became tinged, of a rich golden Colour, and acquired, by digestion in a Sand heat, a grateful fragrancy of Smell, with a hot, pungent, Spicy Taste.

THIS Experiment was made in imitation of the 154th Process in *Boerhaave's* Chemistry; where he shews the method of dissolving common Brimstone in Alcohol or highly rectified spirit of Wine:

Wine: To which *Solution*, the Tincture here obtained bore a perfect resemblance.

In those Deductions which that great Chemist has drawn from this Process, he observes, that Sulphur (by which he means common Brimstone) must first be opened by an Alcaly before it will dissolve in the Spirit.—That this Substance frequently lies concealed in many Fossil Bodies, from whence Tinctures have been extracted, and imposed on the World for the most valuable Metallic ones. An Instance of which he gives in one which was boasted to have been made from Gold, and concludes with an Observation preventive of such impositions. *As soon (says he) as a skilful Artist discovers that a fixed Alcaly is employ'd in making them, he knows they must proceed from Sulphur.* † Con-

† Simul ac enim cognoscitur Alkali requiri ad easdem conficiendas, peritus Artifex acutus cognoscit de Sulphure nasci.

sequently, the Tincture here obtained from the Residuum of the Bath Waters, must proceed from a sulphureous Principle of one kind or other which it contains. But that this is not common *Brimstone* is evident from hence, that when distill'd Vinegar was added to this Tincture, no offensive smell was produced; nor did any thing precipitate which was possess'd of its properties. Whereas, if the same Acid be mix'd with the golden Tincture of the before-mention'd Process in *Boerhaave's* Chemistry, there soon arises a *stercoraceous Odour*, and that *Mineral* subsides.

THE sulphureous Principle therefore which is contained in the Residuum of these Waters bears only this resemblance to common *Brimstone*, that they both give a like Colour to spirit of Wine.

Now if we consider the Composition
of

of that *Fossil*, we shall find it is only one of its constituent Ingredients† which is capable of producing this effect. Neither its Alcaly, nor its Acid Spirit are in any degree equal to it, and therefore it must be its Bituminous Part, or as M. *Homburg* expresses it, *le vrai souffre du souffre commun*, to which this alteration of Colour is to be attributed.

PROBABLY the sulphureous Principle of these Waters may consist of such a Bituminous Matter. The preceding experiment favours such a supposition; and the subsequent ones will, I presume, confirm it.

1. If a large quantity of the Bath Water, as 50 or 60 Gallons, be eva-

† Brimstone consists of an Alcaline Part, an Acid Spirit, and a Bituminous Matter. *Vide*, *Essai de L'Analyse de Souffre Com. Memoirs de L'Acad. Royal, An. 1703.*

porated with a very slow fire nearly to a dryness, or 'till only a Quart or three Pints of it be left; this remainder being poured off from the earthy parts, which the operation has collected, and passed thro' filtrating paper, appears in respect of its Colour like Mountain Wine, and, in its Smell, resembles the Balsam Tolu.

2. If an equal quantity of pure spirit of Wine be poured to this *Amber-colour'd* Water, the mixture immediately becomes turbid and milky, and continues so 'till the precipitation of a saline uncrystaliz'd; Mass restores it to its original transparency and colour: The latter being now render'd fainter by the division of the *Sulphureous Matter*, which produced it, through the additional quantity of the Spirit of Wine.

3. WHEN

3. WHEN this saline Mass has entirely subsided, decant the clear Liquor and gently evaporate it. The Vapour which at first arises is highly perfum'd, but grows less so in proportion as the Spirit of Wine diminishes. When this is entirely exhaled the Watry part of the Mixture recovers its former *Balsamic* smell, and being at length, totally driven away in Steam, there remains a thick soapy Liquor, like common Oil, of a hot, aromatic, pungent Taste, of a grateful fragrancy, and of a dark-brown Colour.

THIS is the sulphureous Principle of the Bath Waters. It's an exceeding fine aromatic Balsam, entirely dissimilar from common Brimstone, which has hitherto been said to constitute this part of their composition.

It is impossible to determine the

precise quantity of this Principle in any assign'd Portion of the Water, because much of it flies off during the several Evaporations which are necessary to collect it.

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It is impossible to determine the

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C H A P. IV.

Of the SALINE and EARTHY PRINCIPLES of the BATH WATERS.

WATER is so ready and so universal a Solvent for all the various species of Salts, that there is hardly ever found a Spring so pure, but some one or other of this Class of Bodies make a part of its contents. Mineral Waters especially are never free from such Ingredients; Among them there are some which derive their whole Virtue from hence; and indeed it would be hard to conceive how without such assistance they could lay claim to that Appellation, or be productive of any Medicinal effects.

THE kinds of Salt which such Waters contain are discoverable by two methods of examination. The first consists in the addition of peculiar Substances to the Water, from whence certain effects ensue that characterize the Salts which produce them: And the second, in evaporating *it* to a dryness, or 'till only an Earthy matter remains, from whence the Salts are afterwards to be separated.

BUT introductory to these Investigations, it may not be improper in this place to premise a short and general History of the different Species and Properties of Salts; which, tho' unnecessary to many Readers, may yet be of such use to others, whose knowledge in Chemistry is of small extent, that without it, the following account of the Salts which are discovered in the Bath Waters would be perfectly unintelligible.

THESE SALTS, then, are defin'd to be **Fo-
sil Bodies**, fusible by Fire, and con-
gealable again by Cold into little
Glebes or Crytals; soluble in Wa-
ter so as to disappear therein, and
impressing a sensation of Acrimony
on the Tongue.†

THIS definition is general, and takes
in the chief properties of all Salts what-
ever; but as there subsist very essential
and peculiar differences among them,
they have been aptly divided in-
to three distinct Classes, which are
distinguished by the terms, Acid, Alca-
line, and Neutral.

THE properties of Acid Salts are
their particular Taste and Smell; the
fermentation they produce with alkaline
and earthy substances; their dissolving

† Note on *Boerhaave's Chemistry*, by *Shaw*, Vol. i. Page 104.

Metals; and their striking a red colour with the Juices of the Sun-Flower, Roses, and Violets.

ALCALIES are characterized by their rankish urinous Taste; by their effervescing with Acids; by their precipitating Metals and other Substances dissolv'd in them; by their readily uniting with Oils and Sulphureous Bodies; by their changing the Juices of the Sun-Flower, Roses, and Violets green; and lastly by their dissolving and running into a fluid state when exposed to the Air.

THE third Class of Salts which are term'd Neutral, are constituted by the union of the preceding ones, and when perfect, neither ferment with Acids nor Alcalies, or indeed possess any of their properties. They are also sufficiently distinguished by their power of crystallizing, or shooting into regular distinct forms,

forms, which belongs not to either of the others.

As all Salts whatever are comprehended under one or other of the preceding Classes, and possess the peculiar Marks of their Tribe; they are in a great measure to be discover'd by the following Experiments, as appears from their application in the present Enquiry.

1. HAVING mix'd some Syrup of Violets with the Bath Water, it soon changed to a deep vivid green.

2. WITH a solution of Quicksilver in Aqua Fortis it immediately became opake and yellow, and an Orange colour'd Powder precipitated.

3. ACIDS cause no effervescence with the Water, but their acrimony is

is greatly heated and destroyed by it.

4. NEITHER with Alkalies is Any fermentation excited.

5. A SOLUTION of Silver in Aqua Fortis turns the Water Milky, and the Metal subsides.†

FROM the two first of these Experiments we learn that the Water contains an Alcaly.—From the third, that this Alcaly is either but in a small quantity, or that it is not of a very active nature.—From the fourth, that no Acid in a separate unmix'd state has any share in its composition.—And from the last, that Common Marine Salt makes a part of its contents.

As the phenomenon produced in the

† The Waters of each Bath shew the same appearances.

second Experiment admits only of the following solution, its explication therefore becomes an evidence for the veracity of that deduction which was drawn from it. A For the Menstruum in which the Quicksilver is dissolved being a strong Acid, is on its mixture with the Water changed to a Neutral State by the Alcaline Principle which exists there; and being thus so much alter'd from its original nature, it consequently is now no longer capable of sustaining that Mineral.

To explain why Milky Clouds are generated in the Water by dropping into it a Solution of Silver in Aqua Fortis, and why from thence, together with the precipitation of that Metal, we conclude it contains common Marine salt: It must be observed, that the two most perfect Metals, Silver and Gold, dissolve each in its own peculiar Menstruum, so as that the one is not in the least af-
fected

fected by what proves a solvent for the
 other.—Thus Silver dissolves in Aqua
 Fortis, but Gold does not.—Again,
 Gold dissolves in Aqua Regia (a liquor
 made by the combination of Aqua For-
 tis with Marine Salt) but Silver is not in
 the least acted upon by it. When
 therefore the solution of Silver is mixed
 with the Bath Water, the common
 Marine salt which is contained in it
 uniting itself with the Aqua Fortis, pro-
 duces that peculiar Menstruum (the Aqua
 Regia) which acts only upon Gold: In
 which case, the Silver must necessarily
 be discharged from a Fluid now ren-
 der'd incapable of dissolving it; and
 thus for a time it swims about in the
 Water, obscures its transparency with
 Milky Clouds, and at length precipi-
 tates to the bottom of the Glass in which
 the mixture was made.

It has been observed of Neutral Salts,
 that they alone have the power of con-
 gealing

gealing into Glebes or Crystals ; the figures of which being extremely different, and each Salt always retaining its own peculiar Shape, this property becomes one of the most distinguishing signs of their several Species.—Thus common Marine salt produces Crystals which are Cubes : Those of Nitre are Prysmatic : Those of Alum Octogons ; and so on of the rest.

Now to obtain the salts of a Mineral Water in this perfection, that from their proper shape it may be determined to what Class they belong, it is necessary to evaporate large quantities of it, that all the fluid part being dispersed in Vapours, the Earthy and Saline ones may alone be left ; from whence the latter are to be separated by digestion in warm distill'd Rain Water, which being filtred and gently evaporated till a fine skin covers its surface, must then be kept in a cool place, and thus the

Salts will in time be found crystaliz'd in their distinct figures.

If the Bath Water is treated according to these directions, it exhibits two species of Salts, whose forms are elegantly express'd in the following Plate, Fig. 1.

BUT I shall defer the particular description of these for the present, to take notice of some phenomena which arise during the methods made use of to obtain them.

WHILE the Water evaporates, its surface is continually covered by broad thin Flakes, which as they gradually increase in their weight by the addition of similar particles, at length become too heavy to be supported; and by subsiding, give room for others of the like nature to succeed. The sides also of the Vessel in which the evaporation is

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performed, are incruſted with a hard, ſaline, white Matter, extremely pungent, and biting on the Tongue.

WHEN the Water is entirely exhale^d, the Reſiduum conſiſts of the before-deſcribed Flaky ſubſtances, and (if the heat uſed during the Proceſs has been moderate) is of a *brown* Colour, has a ſoft ſoapy feel, and a *Balsamic* ſmell. On the contrary, if the heat has been violent, it is depriv'd of all theſe properties. The *Balsamic* ſmell is not to be perceiv'd; its Flocculi become brittle, and harſh to the touch; and change their natural brown for a ſnowy whiteness. Which alterations, are other incontestable Proofs of a Bituminous Principle that originally exiſted in this Reſiduum; by whole eſcape the above changes neceſſarily enſue.

THIS Reſiduum has no diſtinguiſhable Saline taſte, but is rough and gritty in

the Mouth.—It ferments violently with Spirit of Vitriol, and other Acids ; as do also those Saline Concretions which adhere to the sides of the evaporating Glasses. — They raise no disturbance whatever with Alcalies ; and being digested in pure, distill'd, Rain Water, they communicate to it the property of turning *Green* with Syrup of Violets.

SUCH Appearances confirm those conclusions, which were drawn from the changes the Bath Water underwent by the mixture of particular substances with it ; and are further demonstrations of its containing an Alcaline Principle. But whether this is a salt, or only an Earthy Matter inclining to that nature, we must be determined by the following Experiment.

LET a large quantity of the Water be evaporated 'till only a small portion of it remains ; this will be
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extremely salt, and if poured off from the Earthy parts, and exhaled to a dryness, we shall thus collect this principle by itself, and pretty free from every other addition.

THE Saline Mass here obtained, neither ferments with Acids, nor produces any change of Colour with Syrup of Violets: Nor does the white concretion which sticks to the sides of the evaporating Glasses, yield any other than a perfect Neutral Salt, when dissolv'd and crystalliz'd; and its filter'd Solution shews no signs of Alcalescency.—

Hence this Alkaline Principle does not consist in a *Salt*, but in an *Earthy Matter*; of which we shall hereafter speak more particularly.

It has been observed, that there are Two Species of Salts in the Bath Waters: The first of which resembles in its figure Dr. *Lister's* Calcarious Nitre,

and is undoubtedly the same Salt.—
 † Its Crystals are long and slender ;
 they consist of four unequal sides,
 the upper and inferior being broader
 than the lateral ones. At one end,
 the Crystal terminates in Two Trian-
 gular surfaces, at the other, in Two
 inclined Planes. Fig. 2.

THIS Salt is at first remarkably cool
 in the mouth, but impresses a strong
 bitter taste as it dissolves. It's free from
 any acrimonious biting sensation ; nor
 has it that nauseous flavour which the
 common purging Salts leave behind them.
 Being flung into Milk which is near
 boiling, it curdles it, and produces a
Whey. It ferments gently with Spirit

† *Salis Calcarii Crystalli* tenues, longæque sunt: iisque mediis
 quatuor latera parallelogramma sunt at ferè inæqualia ; ex alterâ
 vero parte, ipse mucro ex binis planis lateribus triangularibus
 formatur, ex altera & adversa parte duo plana quadrata habet,
 perpetuò ad contrarium cum priore illa parte positum. — *Tractatus*
de Fontibus Medicatis Angliæ.

of Vitriol, and yields a Gas, which smells like Aqua Fortis. It does not ferment with Alcalies, but turns Syrup of Violets of a faint green. Being flung on a red-hot Iron, it immediately melts, and runs into a fluid state like Water, hisses, forms bubbles, and at length changes into a white Calx. On live Coals it produces the same appearances. If it's put before a Fire, or kept in a hot place, it loses both its transparency and hardness; becomes white, and falls into a powder on the slightest touch.—We confin'd a few Ounces of this Salt in a Glass Retort, and gave it a strong Fire for several Hours. There at first came over into the Receiver a considerable quantity of a tasteless, insipid Water, which gave no Signs either with Acids, or Alcalies, or Syrup of Violets, of its being any other than a pure elementary Fluid. This was followed by a small portion of an Acid Spirit. The Mass which re-

mained in the Retort was an Alcaline Earth.

A SOLUTION of this Salt, precipitates Silver dissolved in Aqua Fortis; which Property is, I believe, not essential to it, but is owing to small portions of Marine Salt, which in the Microscope are seen adhering to its Crystals.

'Tis this Marine Salt which makes the second Species in the composition of these Waters, as is evident from its possessing the following signs.—1st, The Cubical Figure of its Crystals.—2d, Its peculiar Salt Taste.—3d, If the Oil of Vitriol is dropt on it, there arises an acid suffocating Gas, or the true spirit of Sea Salt.

IN 56 cubic Inches, † or one Quart

† The Wine Gallon is supposed to contain 231 Cubic Inches, but from an Experiment made in 1688 before the Commissioners of the Excise, &c. it was found that the precise content of the Standard Wine Gallon kept in *Guildhall* was but 224 Cubic Inches.

Wine

Wine measure of the King's-Bath Water, there is found both by its evaporation and distillation, 34 Grains of Residuum. The proportion of the Water therefore to its fixt Contents, is as 417 to 1.

TWENTY Grains of this Residuum dissolve in Rain Water, the other 14 subside. Hence the former are Salt, the latter Earth.

THESE two species of Salt exist in the King's-Bath Water, under different proportions. The Neutral, being to the Marine Salt, as 2 to 5; consequently in a Wine Quart we have 5,714 Grains of the Neutral Salt, and 14,285 Grains of the Marine Salt.

ONE Quart of the Hot-Bath Water gave 30 Grains of Residuum; 17 of which were Earth, and 13 Salt.

THE same quantity of the Cross-Bath also left 30 Grains of Residuum; 10 of which were Salt, and the remainder Earth.

THE proportion therefore of the Fluid parts to the Solid, in both these Waters, is as 472, 6 to 1.

THE Water of the Hot-Bath contains a larger share of the Neutral Salt, than the Cross-Bath.

AFTER these Salts are entirely separated from the Residuum, there remains an Earthy Powder of a white Colour, and a perfectly insipid Taste.

ITS peculiar Nature will be discovered by the following Experiments.

1st. IT does not ferment with Oil of Tartar, or with any of the Alcaline Class.

2^d. IT

2d. It gives a faint green to Syrup of Violets.

3d. It ferments violently with Spirit of Vitriol, and all other Fossil Acids.

4th. AFTER being calcin'd, it fermented more strongly with Acids than before, but did not increase the Heat of common Spring Water, nor did any hissing or ebullition succeed on their Mixture.

5th. I ADDED to this Earthy Matter a little Borax and Tallow, and then placed it in the Heat of a Wind Furnace for some Hours. When the Mass had grown cold, and was pounded, the Loadstone drew several small particles of Iron from it.

FROM these Experiments we may with certainty conclude, that the Earthy
part

part of the Bath Water is of an alkaline Nature ; but it does not seem to be derived from Lime Stone, as in that case it would have shewn its peculiar properties after *calcination*, and consequently have produced an ebullition with Spring Water, and increased its Heat.

It also appears that the Calx of the *Chalybeat* Principle of these Waters remains in their Residium, and may be restored by proper methods to its genuine Metalleity ; which is surely a convincing Proof that the general opinion of its being *Volatile*, is erroneous.

THE Earthy Ingredient of these Waters is also to be obtained, by only mixing the Salt of Tartar or its Lixivium with them ; for immediately on this addition, large white Clouds appear, and at length precipitate in a fine Powder ; which (after being well wash'd in several Waters, to separate any part of
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the Alcaly which might have adhered to it) fermented violently with all the Mineral Acids in general.

THIS Powder shews no Signs of Inflammability whatever; it's merely an insipid, absorbent, alkaline, chalky Earth.

THE last Principle which we find in the Bath Waters, is Elastic Air. It has been observ'd by Dr. *Hales* that they contain less of this Element than other Mineral or even Common Waters do; and by following his method of separating the Air from Fluids †, I obtained from a Florence Flask of the King's-Bath Water by 160 Degrees of Heat, a Bubble, whose diameter was only $\frac{1}{8}$ of an Inch; from the Hot-Bath Water one of $\frac{3}{8}$; and from the Cross-

† See *Veg. Statics*, Vol. 2, Page 270.

Bath about the same quantity : Whereas a Florence Flask of common Pump Water yields a Cubic Inch of Elastic Air.— Those of *Bristol* and *Holt*, a like portion ; and *Piermont* Water, near twice as much. †

† See *Veg. Statics*, Vol. 1, Page 181.

C H A P. V.

How the BATH WATERS are generated.

WE learn from the preceding Analysis, that Elementary Fire, Elastic Air, an Alcaline Earth, a Neutral Salt, Common Marine Salt, Iron, and a fine Aromatic Balsam, mixed together and dissolved in pure Water, constitute these Fountains of Health.

How Spring Water becomes possess'd of those rich Ingredients, or in other Words, how the Bath Waters are generated, I shall now attempt to explain; and if I am able to make an Artificial Water, which shall resemble the Natural one in its most essential Characteristics, it

it is all that can be expected in so difficult an Undertaking.

It has already been observ'd that these Waters bring up with them a very peculiar sort of sand, which is composed of an Alcaline Earth, Iron, and Brimstone.—Upon the supposition then that common Spring Water, by running through large Beds of this Sand, becomes impregnated with the same Principles which we find in the Bath Waters; let us try how far the imitation of them will succeed, by making this the foundation of our enquiry.

I MIXED with equal quantities of filings of Iron and of Stone Brimstone, both reduced to a powder, about four Times their weight of Free-stone Sand. This Composition was moisten'd into a paste with common Water. In about 16 hours it became so violently hot as to break
in

in pieces a strong Earthen Pan in which it was kept ; and it had lain scatter'd, and smoaking on the Ground, for some time before it was discover'd.

THIS accident render'd a repetition of the Experiment necessary : Which being made in a metalline Vessel, the Success was equal to expectation ; for the Water poured on this Mixture grew hotter than that of the Bath, and having inadvertently suffered a Farenheit's Thermometer to sink too deep among the Ingredients, the Mercury was flung up to the utmost extent of the Tube, whose Scale measured 393 degrees, and the Bulb of it burst.

THIS Water in which the above Composition was digested, threw up a little Scum on its surface, and deposited an Ocre on the sides of the

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Vessel

Vessel which contained it. † It was transparent and vivid—It had an agreeable chalybeat taste—It instantly turn'd purple with Tincture of Galls—Green with Syrup of Violets—Of an Orange colour with a solution of Quicksilver in Aqua Fortis—Milky with Oil of Tartar per Deliquium—It precipitated a solution of Silver, and shew'd no change or alteration whatever with Acids.—In all which particulars it perfectly agrees with the Bath Water. Some difference was however observ'd between them, which arose from the different proportions of their several Ingredients; and not from the defect of any particular one, in the composition of the Artificial Water, which contained more of the Chaly-

† The Guides clear the Surface of the Baths of this kind of Scum every Morning before the Bathers come in.—An Ocre may be seraped off the Sides and Stone-Seats of the Baths, which are in most places tinged by it of a yellowish colour.

beat,

beat, and less of the Alcaline Principle, than exists in the other.

THE Artificial Bath Water left by evaporation a Residuum of a brownish colour, which gave no flame on a red-hot Iron, but communicated a fine amber Tincture to spirit of Wine : And part of it being digested with distill'd Rain Water, and the solution crystaliz'd, the same species of Salts were obtained, as those which the Natural Water yields by the like treatment.

FROM this Analogy between the Artificial and the Natural Waters, it is evident the latter are generated in the manner I have supposed. Those small differences which have been notic'd between them will scarcely be call'd objections to this Theory : For it would be absurd to imagine that Chemistry can afford us the power of making so

perfect a Composition, as that which Nature produces. It is the province of this Art to imitate her operations, and from that imitation to explain them. For, as Mr. *Lemery* observes, † ‘ Le
 ‘ meilleur moyen d’expliquer la Nature,
 ‘ (s’il pouvoit être employé souvent) ce
 ‘ seroit de la contrefaire, & d’en don-
 ‘ ner pour ainsi dire, des représentations
 ‘ en faisant produire les mêmes effects
 ‘ a des causes que l’on connoîtroit, &
 ‘ que l’on auroit mises en action.
 ‘ Alors on ne devineroit plus, on ver-
 ‘ roit de ses yeux, & l’on seroit sûr que
 ‘ les Phenomenes naturels auroient les
 ‘ memes causes que les artificiels, ou du
 ‘ moins, des causes bien approchantes.’

It now only remains, that we shew, how from the action of these Bodies on each other, the several Principles of the Bath Waters are produced. To this

† Hist. de l’Acad. Roy. An. 1700.

end, it must be premised that Iron powerfully attracts Acids ; and that Brimstone is composed of an Acid Spirit, a Bitumen and an Alcaline Part.—When these two Bodies then come into close contact, a solution of the Iron, by the Acid Spirit of the Brimstone, immediately commences. By this means, that Metal is converted into a Salt or Vitriol ; which Salt or Vitriol makes the *Chalybeat* Principle of the Bath Waters.

WHEN the Acid Spirit is thus separated from the Brimstone, its Bituminous and Alcaline Parts only remain : The former of which being rendered soluble in Water by the Assistance of the latter, constitutes the *Sulphureous* Principle of the Bath Waters.†—Hence we see it is

† Cette Balsam tire du soufre commun a une odeur grate & balsameque.—Analyse du Soufre par M. Homberg.—*Memoirs de l'Acad. Royal, An. 1703.*

impossible that these Springs should contain common *Brimstone*, as in their production the texture of that Mineral is entirely destroy'd, and it is robb'd of one of its *Constituents*.

THE *Alcaline* Principle of the Bath Waters is supplied either from Free-stone Sand, or some Chalky Earth: Probably from the latter, as the Artificial Water was found to contain less of this Ingredient than the Natural one.

MARINE Salt, or Sal Gemmæ (for they are both the same) is so universally distributed through the Bowels of the Earth, that there are no Spring Waters but what are impregnated with some portion of it.

THE Calcarious Nitre, or Neutral Salt of these Springs, is composed of a Vitriolic Acid, and an Alcaline Earth; and does not, I believe, primarily exist
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in them, any more than it does in the Artificial Water, which has been made in their imitation; but is generated while the Waters evaporate. For Heat applied to the Bath Waters, as well as to all other Chalybeats, deprives them of their properties of tinging with Galls; that is, it separates the Acid from the Iron by which it was render'd miscible with the Water, and the Metal subsides: While the Acid Spirit, in which it was before dissolv'd, is absorb'd by the Alcaline Earth, and this Neutral Salt is form'd.—Hence we see the Reason why no *Vitriol* or *Salt* of *Iron* is ever to be found in the *Residuum* of Chalybeat Waters; why this Principle exists there in the state of a *Calx*; and why from all Waters of this Class we obtain a *Neutral* Salt of the same kind.†

† In Pyrmontanis, in librâ unâ Salis medii grana vii ad x continentur; in Egranis & Salterensibus grana plura; in Sualbecensibus & Spadanis, pauciora.—Heister de Aquar. Medicatarum naturâ et usu.

HOFFMAN, speaking of this Salt, observes, ‘ † That it cannot be discover’d, by the addition of any particular Substances to the Water, but readily by exhaling it to a dryness:’—For which, if the above supposition is admitted, we can be at no loss to account.

THE last thing to be explained, is the remarkable heat with which these Waters are endued; and here, if I have recourse to the antient Opinion, that Fire is an Element sui generis, and that it makes a part in the composition of all Bodies whatever; I shall not be unsupported by many great Names among the Moderns, such as *Homborg*, *Lemery*, *Gravesande*, and *Boerhaave*. It may also be added, that the late

† Quod reagentium ope difficulter admodum, vel plane non erui & detegi possit, sed sola Liqueoris exhalatione & resiccatione sese conspiciendum præbeat.—*Hoffman de Elementis Aquarum Mineralium, &c. Sect. 50.*

discoveries in Electricity tend very much to confirm and establish this Doctrine. I choose therefore to ascribe that great degree of Heat which is found in the Bath Waters to Elementary Fire, as to its most probable Cause. *This*, if it exists in any Bodies at all, does so most eminently in Iron and Brimstone. It should seem then, that these Waters, by washing off, separating, and taking up, in their passage thro' the Earth, the Particles of these Minerals, set at liberty this imprisoned *Element*, which thereupon communicates its Warmth and Activity to the Fluid.

I KNOW not, whether I have given
the Reader all the Satisfaction he ex-
pected in the perusal of the foregoing
Sheets. This I am sure of, that the
Experiments were carefully made, and
the Success of them is faithfully related.
The great Mr. Boyle observes, that
' To discover the Nature of Mineral
G ' Waters

‘Waters, is a far more difficult task than those who have not tried would imagine.’ The difficulties I met with in the preceding Analysis, have thoroughly convinced me of the Justness of this Observation. But in proportion as the Attempt is arduous, the Candour and Indulgence of the Public may be hoped for. To them therefore it is submitted, with that unprejudiced Temper of Mind which ought to be inseparable from every Enquirer after Truth : And if any Gentleman who may make these Experiments after me, or may fall upon others more decisive, should discover any Errors in this little Tract, its Author will thank him for the Information.

F I N I S.